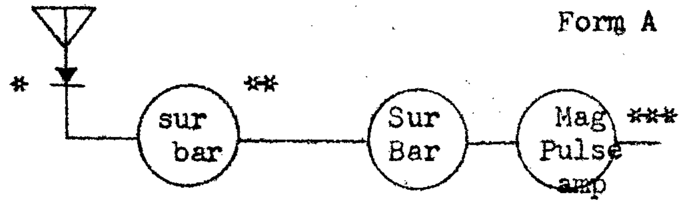
This is being held
for evaluation
after receipt of
ref (Design Electronics
aug '54)

(Reference by D.E.
covers only small signal
pulse amplifiers.

Declassified and Approved For Release 2012/09/13 :
CIA-RDP78-03535A000500050002-8

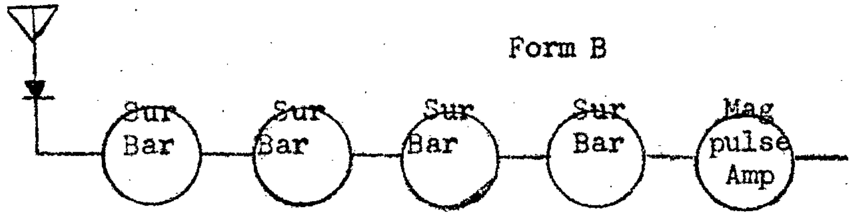
Form A



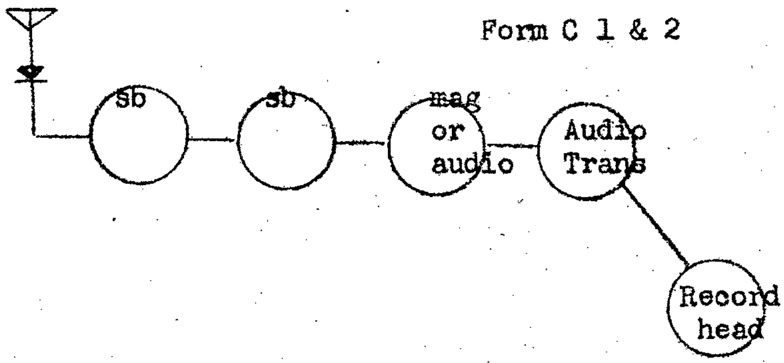
* All Video Crystals with ca 25 to 40 micoAmp. forward bias.

** Surface-Barrier Transistors

Form B



Form C 1 & 2



Form A is considered to be a video preamplifier system only.

Form B is considered to be a video preamplifier with sufficient gain to permit direct audio monitoring and or recording with any conventional recorder/amplifier system.

Form C 1 is the addition to form A of an transistor audio output (100 to 10000 cps) power stage to permit full magnetic tape recording into standard magnetic tape head (or Pierce 360 wire head).

Form C 2 is the addition to form A or B of sufficient transistor audio output power stages to permit full magnetic recording into standard tape or wire head without utilizing the magnetic pulse amplifier stage. This unit should consider video band pass low frequency cutoff of 20 kc as well as 100 cps.

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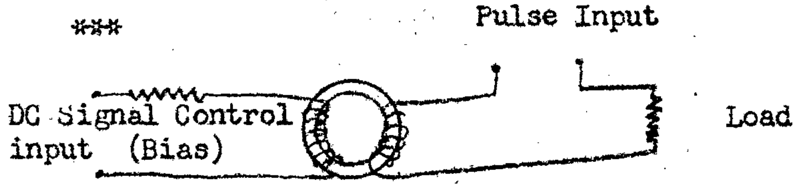


GE Magnetic Pulse Amplifier (Design Electronic Aug '54)

Surface-Barrier Transistor

The Surface-Barrier transistor has great appeal to circuit application engineers, because it enables them to obtain the low-power advantages of junction triode transistors in many new applications. The high cut-off frequency of these devices means that useable gain can be obtained in the very-high-frequency range. Further-more, because of their high cutoff frequency and low capacitance, these devices make good video amplifiers.

Video Amplifier:

One of the most interesting video-amplifier configurations is that in which a number of similar stages are cascaded directly together. This condition is of particular interest because it is not possible to employ transformer impedance matching in a video amplifier. Furthermore, it has been found that the most efficient use of transistors for this function is obtained by using a grounded-emitter connection for all transistors. When this configuration is employed, the input impedance of any stage is equal to the load impedance of that stage, since the load impedance is the input impedance of the next stage.

On the basis of the assumption of equal input and load impedances, the voltage gain of a low-pass amplifier is equal to the magnitude of the current gain. The bandwidth of such a stage will be determined by either the alpha cutoff frequency of the collector capacitance. When the alpha cutoff is the limitation, and if it is assumed that the frequency dependence of alph is like that of a single-section low-pass filter, the gain-bandwidth product of a single stage is very nearly equal to the alpha cutoff frequency of the transistor used in the stage. When collector capacitance limits the bandwidth, the gain-bandwidth product is the reciprocal of the product of the base resistance and collector capacitance, as in the case of the tuned amplifier. The only difference is that, in this case, it may be necessary to consider the low-frequency base resistance. For almost all Surface-Barrier Transistors, the gain-bandwidth product due to collector capacitance is appreciably higher than that due to alpha cutoff, and consequently is of little importance.

A two-stage video amplifier useing similar transistors having alpha cutoff frequencies of approximately 50 mc., gave the performance shown in the attached figure With all four coils in the circuit shorted, the bandwidth and transient response were as shown in B, a bandwidth of 3.2 mc was obtained. The gain between the 1000-ohm source and the load impedance was 28 db. This gave a gain-bandwidth product of 16 mc. per stage. This figure is lower than the predicted value of 50 mcs. for two reasons: First, the supply resistors dissipate some of the power gain in the first stage. When shunt chokes were employed in series with these supply resistors, to raise their impedance at the higher frequencies, the bandwidth was increase to 6.5 mcs, as shown in C, giving a gain-bandwidth product of 33 mc. for each stage. Second, the circuit and collector capacitances cause some bandwidth limiting. Adding series peaking coils L3 and L4, in order to resonate the collector capacitances, increased the bandwidth to 9 mcs., as shown in D., and made the gain-bandwidth product equal to the theoretically predicted value. Part C and D also show the resultant improvement in transient response. Thus it is evident that, although the collector capacitance is not sufficiently great to predominate in limiting bandwidth, it can have an appreciable effect.

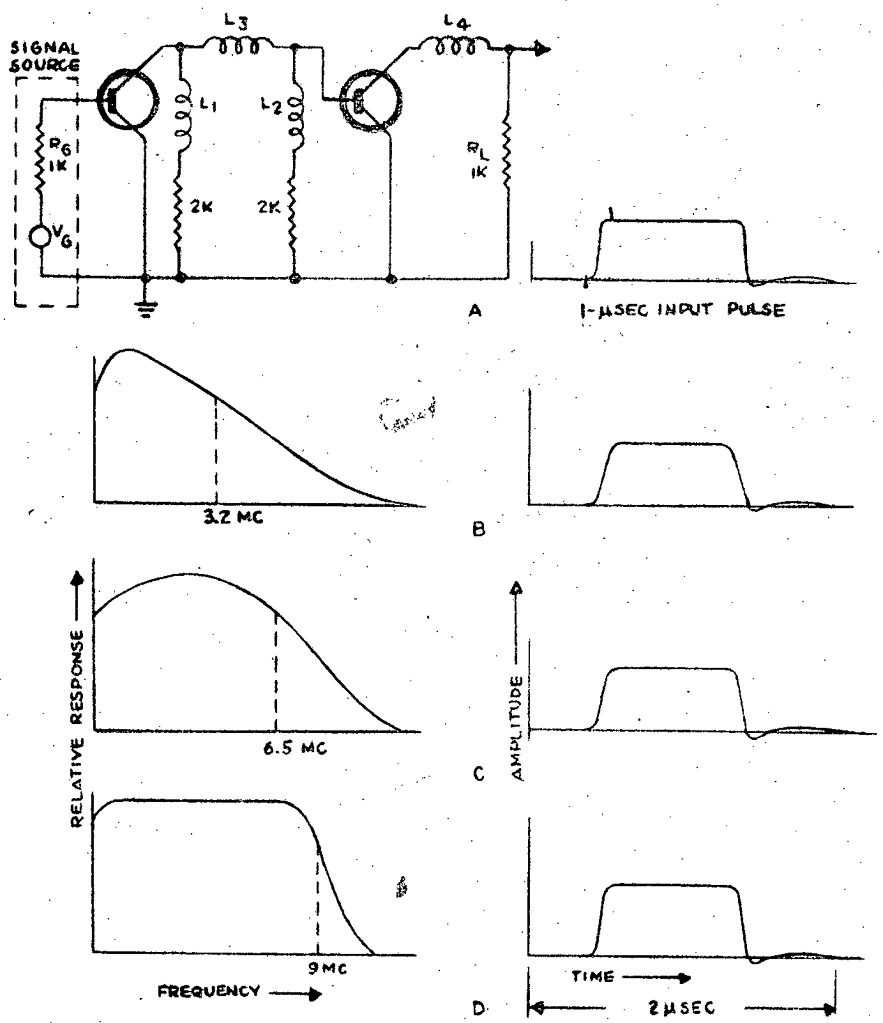


Figure 6. *Two-Stage Video Amplifier Using Surface-Barrier Transistors*

A. Simplified Schematic and Input Pulse

B. Frequency and Transient Response with All Four Peaking Coils Shorted ($L_1 = L_2 = L_3 = L_4 = 0$)

C. Frequency and Transient Response with L_1 and L_2 in the Circuit ($L_3 = L_4 = 0$)

D. Frequency and Transient Response with All Four Peaking Coils in Use

VIDEO AMPLIFIER NOTES:-

Amplifier Response & Gain -

Examination of the performance of a video amplifier requires a determination of:

a. Maximum gain
b. Band width
c. The manner in which the video sensitivity varies for changes in both input pulse length and pulse repetition frequency.

Amplifier maximum required response not directly related to recorder response.

a. Video sensitivity of an amplifier normally decreases as the pulse time duration (width) becomes shorter and as the pulse repetition frequency becomes less.

b. The reduction of sensitivity with pulses of shorter time duration is a function of the "limited" bandwidth of the amplifier, in that amplifier rise-time is not sufficient to allow the signal within the amplifier to reach maximum amplitude before the end of the input pulse.

c. Average input power increases directly with the pulse repetition rate of the signal.

d. The video bandwidth (within which the gain is not down more than 3 db from maximum) required is from 20 cycles to 750kcs for optimum sensitivity against pulses of about one microsecond duration. This amplifier range provides an adequate rise-time and thus permits amplification of short pulses without a loss in sensitivity.

e. Effective average input power increases of low pulse repetition frequencies can be accomplished when a means is provided for stretching the video output from the video amplifier prior to amplifying it in the audio output stage prior to recording. This stretching circuit must necessarily charge through a low impedance in order to completely charge with-in the time-duration of the signal, or there will be a loss in the amplitude of the output signal.

f. Associated redorder media frequently have a maximum response of 100 to 4000 cycles other recorder units permit increase frequency response but only at a cost or weight, size and/or maximum duration of recording time.

Compromise achievable.

Adequate amplifier band width permits a maximum possibility for maximum complete amplification of pulses of short duration. Pulse stretching then permits an effective increase of power output by increasing the amplitude of the audio components of the signal, specifically the fundamental pulse repetition frequency and its lower harmonics falling within the audio frequency response range of the operator or recorder.

Video Notes:

Video amplifiers and pre-amplifiers can be designed to eliminate or greatly reduce crystal noise through the low-frequency cut-off characterisitics. Normally this cutoff covers the audio range up to 20 kcs. These units can not be employed against continuous wave with voice-frequency modulations.

Video amplifiers and pre-amplifiers can be designed through the use of larger by-pass and coupling capacitors so as to permit receiption of audio modulations but will include considerable inherent crystal noise.

AN/PRR-6 video amplifier has a band pass from 20 kc to 1.7 mcs. This permits complete amplification of pulses of 0.25 microsecond duration.

Additional band-pass can be incorporated in vacuum tube units only at the expense of battery life.

Video amplifiers can be designed to permit adequate amplification to permit s study and determination of both pulse width and pulse shape characterisitics. The useability of these features is dependent upon the associated equipments and methods to be utilized in the actual measurment and determination of the wave shapes envolved.

1 September 54

Modification Proposal

Featuring a possible addition to the Minifon modifications now encompassed within framework of Shop Job No. [redacted]

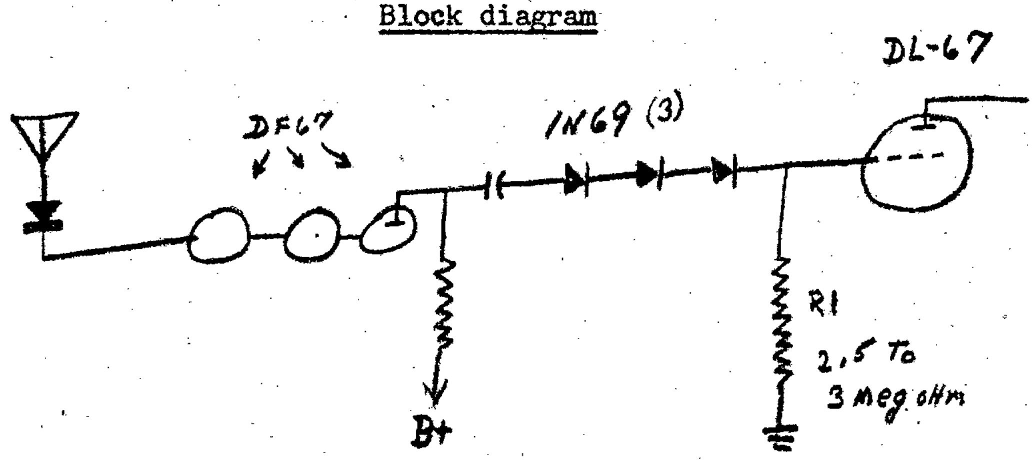
A possibility exists for the current modification being applied to the Minifon recorder unit being made of greater operational potential through the incorporatio of a pulse-stretcher feature so as to obtain greater effective power where low pulse repetition frequencies may be encountered.

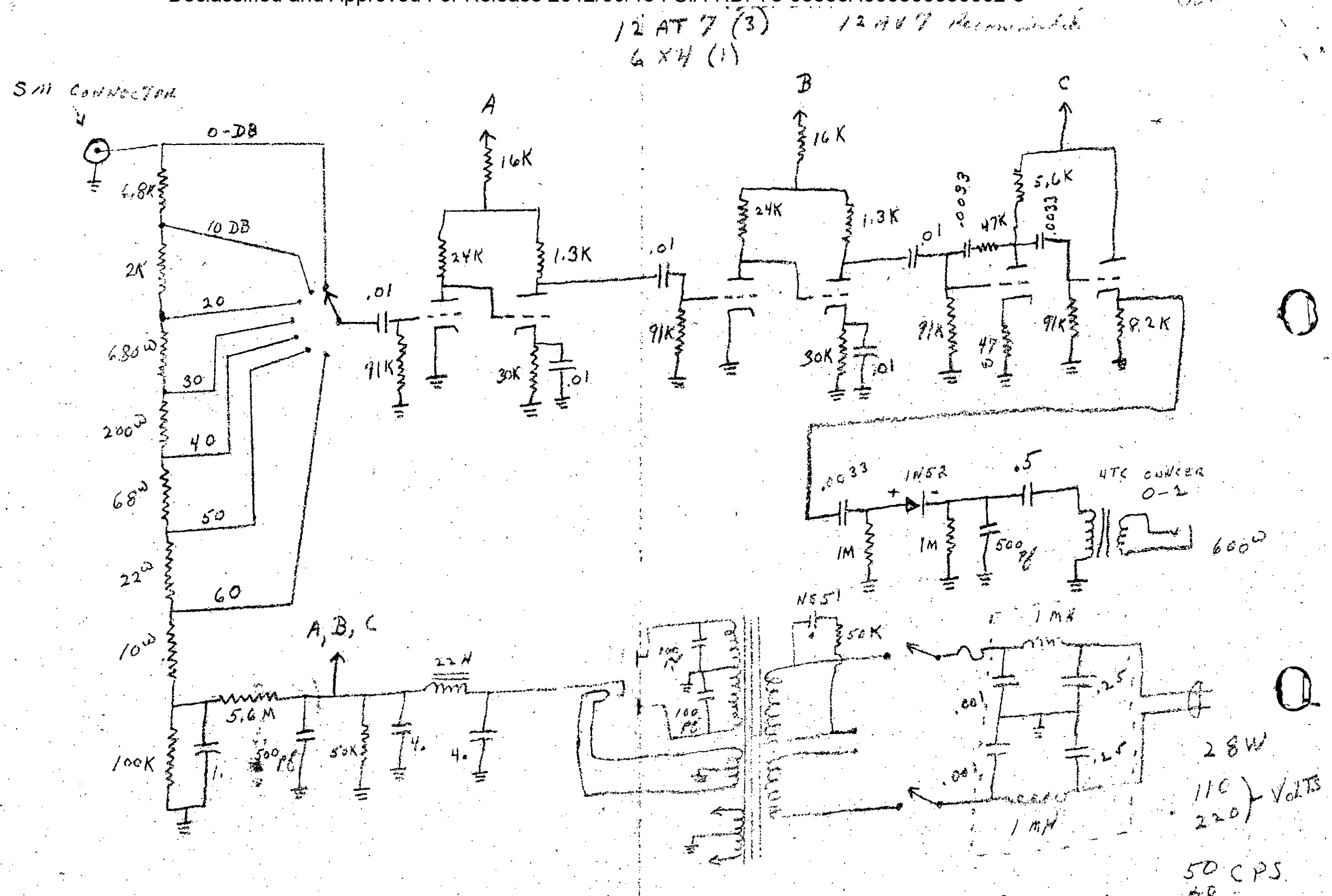
Pulse stretcher to consist of three 1N69 crystals and an RC circuit comprising R1 and the interelectrode capacity of the Minifon DL-67 output tube found between grid and ground.

Pulses of positive polarity are applied to, and passed by, the 1N69 crystals. Since the interelectrode capacity of the DL-67 is of comparatively small value, it charges rapidly to the peak a-c voltage of the pulse. Because of the high back impedance of the 1N69 crystals, the interelectrode capacity discharges through R1, the high value of which (in the order of 2.5 to 3 megohms) slows the rate of discharge. A sawtooth waveform with a shallow exponential trailing edge thus is producee and is applied to the grid of the DL-67 audio amplifier. This causes the amplitude of the low-frequency components of the resultant wavefor to be considerably increased, at the expense of the amplitudes of the high-frequency components.

~~Since these low-frequency components fall within the audio range of the operator~~ /or recorder, and the high-frequency components do not, the effective signal power delivered to the output is increased.

Block diagram





SHUNT - SERIES PEAKING COILS WILL INCREASE GAIN AND BAND WIDTH TO AN AMOUNT OF ABOUT 30%

Tiny Pulse Amplifier......A tiny, stable pulse amplifier that works at extremely low signal levels, has been developed by the General Electric Co., Schenectady 5, N.Y. Preliminary tests indicate that drift is less than 10^{-16}w over a temperature range of -70°C to 140°C. The circuit diagram for the unit is shown below with a photograph of the amplifier.

The amplifier is essentially a magnetic amplifier that uses a very small high-permeability core and requires no rectifiers. The two greatest sources of drift in conventional magnetic amplifiers - variation in rectifier and magnetic core characteristics - have been eliminated in the pulse amplifier.

Drift problems in the conventional magnetic amplifiers are largely attributed to forward rectifier drop reverse rectifier leakage, and variations in the magnetic characteristics between cores. By eliminating the rectifiers, reducing the number of operational cores to one per amplifying stage, and by operating this core in push-pull, the pulse amplifier has considerably less opportunity for drift. The circuitry is so devised that variation in saturation flux density and hysteresis loop width have negligible effect. Changes in the hysteresis loop affect the gain only, not the level of drift.

In operation, the magnetic core of the amplifier is driven into saturation by the power pulses. Between pulses, the core magnetization settles back to a level dictated by the control signal. The output power is determined by the amount of pulse remaining after saturation. Push-pull operation is achieved, using a single magnetic core, by comparing the alternate positive and negative pulses. Approximately the same gain and speed of response are realized in the pulse amplifier as in the conventional magnetic amplifier.

Basically a low-level device, the pulse amplifier can be used to amplify a signal to the microwatt level. Here conventional amplifiers can be used to boost the power to higher output levels without further effect upon the drift. The concept of the pulse amplifier suggests a wide variety of new functions that may be performed by magnetic amplifiers. These cover the fields of optical pyrometry, precision calorimetry, spectroscopy, geophysics, meteorology, differential thermometry, etc. Wherever extreme sensitivity is desired, the pulse amplifier has an application.

Materials used to make the cores of the pulse amplifier are the same as those used in conventional magnetic amplifiers - silicon steel, nickel-iron alloy, permalloy, Mumetal, etc.